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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER	
BROOME, SAID A	

ART UNIT	PAPER NUMBER
2628	

DATE MAILED: 11/15/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	**Application No.**	**Applicant(s)**
	10/720,042	STROM ET AL.
	Examiner	**Art Unit**
	Said Broome	2628

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *9/8/2006*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,3,5-15,17,19-23,25-27 and 31-41* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☒ Claim(s) *13 and 14* is/are allowed.

6)☒ Claim(s) *1,3,5-11,15, 17,19-23,25-27 and 31-41* is/are rejected.

7)☒ Claim(s) *12* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 9/8/06 has been entered.

Response to Amendment

1. This office action is in response to an amendment filed 9/8/2006.

2. Claims 1, 3, 5, 9, 11, 13, 15, 20, 23, 26 and 31-40 have been amended by the applicant.

3. Claims 2, 4, 16, 18, 24, 28-30 have been cancelled.

4. Claims 6-8, 10, 12, 14, 21, 22, 25 and 27 are original.

5. Claim 41 is has been added.

Claim Objections

Claim 25 is objected to because of the following informalities: the preamble of the claim refers to a cancelled claim. Appropriate correction is required.

Claim Rejections - 35 USC § 101

35 U.S.C. 101 reads as follows:

> Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

Claims 1, 3, 5-14, 31-38 and 41 are rejected under 35 U.S.C. 101 because they appear to be directed to an abstract idea rather than a practical application of the idea. The claimed invention does not result in a physical transformation nor does the claimed invention appear to provide a useful, concrete and tangible result. Specifically, the claimed invention does not appear to produce a tangible result because merely defining a plurality of rows of tiles, are nothing more than thoughts or computations within a processor. It fails to use or make available the result of defining and processing rows of tiles to enable its functionality and usefulness to be realized. Additionally the asserted practical application in the specification of the graphics processing method is to perform the processing methods of the applicant's Figures 2-8 on a portable electronic device, as described in the Specification on page 9 lines 21-24 and on page 15 lines 30-34 – page 16 lines 1-2. The practical application is not explicitly recited in the claims.

Claims 15, 20 and 30 are directed to an apparatus that solely calculates a mathematical algorithm, which is non-statutory subject matter. Claims 15, 20 and 30 are directed to a generic computing system (i.e. display unit, a graphics processor) for performing a mathematical algorithm without expressly reciting a practical application. In effect, claims 15, 20 and 30 seek to cover every substantial practical application of the abstract idea itself.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1, 5-11, 15, 19-22, 23, 26, 27 and 31-41 are rejected under 35 U.S.C. 103(a) as being unpatentable over Xie et al.(herein "Xie", US Patent 6,525,726) in view of Larson (US Patent 6,313,839).

Regarding claim 1, Xie teaches defining a plurality of rows of tiles in a graphics display field comprising a plurality of rows of pixels, each tile including pixels from at least two rows of pixels in column 4 lines 43-46. Xie teaches setting occlusion flags for respective tiles of a row of tiles for a graphics primitive based on whether respective representative depth values for the tiles of the row of tiles meet an occlusion criterion in column 5 lines 1-2 ("Polygons which are determined to be visible, at least partially, by the HZ buffer test…"), as shown in Figure 2 as step 50, where it is described that as occlusion is tested, an indication of the results of the test is recorded to represent the visibility. Xie also teaches processing pixels in rows of pixels corresponding to the row of tiles for the graphics primitive in a row-by-row manner responsive to the occlusion flags in column 8 lines 57-58 ("…the tiles of display screen 18 are processed sequentially."), where it is described that the pixels within the tile are processed sequentially, therefore the sequential processing of the pixels within each tile is also sequentially processed for each row within that tile, therefore it is implicitly taught that the pixels are processed in a row-by-row manner. Xie teaches processing a portion of pixels in a first tile of the row of tiles responsive to the occlusion flags and depending on the geometry of the primitive, processing pixels in a second tile of the row of tiles responsive to the occlusion flags before processing additional pixels in the first tile responsive to the occlusion flags in column 8 lines 58-67 ("the tiles of display screen 18 are processed sequentially…The process also goes to box 132, in an "early bailout" mode as mentioned earlier, if the nearest Z extent of the bin is further than the

furthest Z-buffer value in the tile, indicating that no further polygons in this bin are visible."), where it is described that once a first tile is processed, a second subsequent tile may be then processed before processing additional portions of the first tile. However, Xie fails to teach the remaining limitations. Larson teaches that occlusion flags are stored in a tile occlusion cache that is configured to store respective occlusion flags for respective tiles of a row of tiles and respective occlusion threshold depth values for the respective tiles of the row of tiles and in column 5 lines 33-35 ("The cache memory element contains a sufficient number of locations for storing Z values for at least one region of pixels and the Z MAX and Z MIN values for the region.") and in column 6 lines 23-25 ("...a determination is made as to whether the primitive is visible."), where it is described that the determination of visibility is performed for the tile of pixels, therefore an indicator is acquired that provides the result of the tested visibility. Larson also teaches determining a maximum depth value for the graphics primitive within a tile in column 4 lines 30-32 ("...the Z values within each region are compared to determine...the maximum Z value, Z MAX, for each region."). Larson implicitly teaches comparing the maximum depth value to the cache occlusion threshold depth value for the tile in the tile occlusion information cache, in column 6 lines 25-27 ("The received Z value is then compared with the Z MIN value. If the received Z value is less than Z MIN, the primitive is visible."), where it is described that comparing the maximum depth value of a tile to the cached depth value to determine visibility is equivalent to comparing any particular depth value to a cache minimum depth value because both comparisons enable the determination of visibility of a particular region or tile of pixels in relation to previously stored depth values. Larson also teaches setting an occlusion flag for the tile responsive to the comparison in column 6 lines 26-29 ("If the

received Z value is less than Z MIN, the primitive is visible...the received Z value is written to the corresponding location in cache memory, as indicated by block 81..."), where it is described that an indication of occlusion is produced, such as a tag or flag, from the result of the test which indicates the occlusion properties of the tile. It would have been obvious to one of ordinary skill in the art to combine the teachings of Xie with Larson because this combination would enable a reduction the amount of processing required to display a primitive through dividing the display into tiles in order of their respective depth values, as taught by Xie in column 3 lines 10-15, in which during processing of the tile the cached depth values of those regions are compared to determine if the tiles are occluded, as taught by Larson in column 1 lines 19-28, thereby avoiding unnecessary processing of hidden primitives.

Regarding claim 5, Xie teaches establishing a depth buffer configured to store respective occlusion threshold depth values for respective pixels of the graphics display field in column 2 lines 29-32 ("The method comprises rendering the polygons in each tile of the scene in depth order, starting with a closest polygon, and storing their pixel depths in the Z-buffer."). Xie teaches performing a test on each tile to determine occlusion in column 5 lines 22-24 ("Polygons from subsequent bins undergo the visibility test (box 50) against the HZ buffer before they are rendered."), therefore with respect to the illustrated steps 50-62 of Figure 2, it is shown that an indication of the result of the occlusion test is performed in step 50, including non-occlusions in which as a result of the resultant non-occlusion, the process would progress to step 54, as described in column 4 lines 66-67-column 5 lines 1-8 ("...any polygons determined to be occluded by the HZ buffer test are discarded...Rendered polygons are converted to pixels...The pixels are shaded...and they are then scan-converted (box 56) and...In box 60, polygon

occlusion statistics are updated."). Xie illustrates processing the pixels comprises detecting that the tile has an occlusion flag indicating non-occlusion in step 50 of Figure 2, where an occlusion test is performed on the tile, therefore an indicator is produced which would provide an indication of non-occlusion. Xie illustrates responsively processing a pixel for the graphics primitive in the tile without retrieving an occlusion threshold depth value for the pixel from the depth buffer in step 106 of Figure 3A, where it is illustrated that the pixels defining the graphics primitive are processed without referencing an occlusion threshold depth value.

Regarding claim 6, Xie fails to teach the limitations. Larson teaches establishing a color buffer configured to store respective color values for respective ones of the pixels of the graphics display field in column 1 lines 13-19 ("...systems typically comprise a frame buffer memory which stores the color and Z coordinate associated with each pixel to be displayed...A frame buffer controller of the computer graphics display system controls the process of writing the Z coordinates and the colors of the pixels to the frame buffer memory..."), where responsively processing a pixel for the graphics primitive in the tile without retrieving an occlusion threshold depth value for the pixel from the depth buffer comprises responsively storing a color vale and a depth value for the graphics primitive for the pixel in the color buffer and the depth buffer respectively in column 1 lines 13-28 ("...systems typically comprise a frame buffer memory which stores the color and Z coordinate associated with each pixel to be displayed...Z buffer depth comparison tests are used to determine whether a new Z coordinate received in the frame buffer controller corresponds to a pixel that will be visible when displayed, or whether the pixel associated with the new Z coordinate will be occluded or hidden if displayed. If the pixel will be occluded, it is unnecessary to write the Z coordinate and the associated color to the frame buffer

memory and the pixel can be discarded."), where it is described that visible pixels are displayed without retrieving threshold depth values and the frame buffer or color buffer contains the color of those displayed pixels.

Regarding claim 7, Xie fails to teach the limitations. Larson teaches that occlusion flags are stored in a tile occlusion cache that is configured to store respective occlusion flags for respective tiles of a row of tiles and respective occlusion threshold depth values for the respective tiles of the row of tiles and in column 5 lines 33-35 ("The cache memory element contains a sufficient number of locations for storing Z values for at least one region of pixels and the Z MAX and Z MIN values for the region.") and in column 6 lines 23-25 ("...a determination is made as to whether the primitive is visible."), where it is described that the determination of visibility is performed for the tile of pixels, therefore an indicator is acquired that provides the result of the tested visibility. Larson also teaches comparing the depth value to the cache occlusion threshold depth value for the tile in the tile occlusion information cache in column 6 lines 25-27 ("The received Z value is then compared with the Z MIN value. If the received Z value is less than Z MIN, the primitive is visible."). Larson teaches updating the occlusion threshold value depth value for the tile in the tile occlusion information threshold cache to the determined depth value for the graphics primitive for the pixel responsive to the comparison in column 2 lines 24-29 ("If a determination is made by the controller that the received Z value is less than the minimum Z value for the region, the minimum and maximum Z values for the region are updated using the received Z value."). The motivation to combine the teachings of Xie with Larson is equivalent to the motivation of claim 1.

Regarding claim 8, Xie fails to teach the limitations. Larson teaches an aggregate tile occlusion information memory configured to store respective occlusion threshold depth values in column 4 lines 30-34, where it is described that a memory area stores the minimum and maximum depth values, or occlusion threshold depth values, within each region, which is equivalent to a tile comprising a block of pixels consisting of rows. Larson also teaches reading out z max and z min, which are occlusion threshold depth values, from the z limit buffer, which is stored in memory, and storing them into the cache memory in column 2 lines 40-51. Larson teaches updating the z min, or occlusion threshold depth value, in the cache memory in column 6 lines 23-33. It would have been obvious to one of ordinary skill in the art to combine the teachings of Xie and Larson because this combination would provide efficient storage of depth values for a region, which would then be utilized to determine and to responsively update occlusion properties for pixels within that region thereby reducing memory processing.

Regarding claim 9, Xie teaches defining a plurality of rows of tiles in a graphics display field comprising a plurality of rows of pixels, each tile including pixels from at least two rows of pixels in column 4 lines 43-46. Xie also teaches setting occlusion flags for respective tiles of a row of tiles for a graphics primitive based on whether respective representative depth values for the tiles of the row of tiles meet an occlusion criterion in column 5 lines 1-2 ("Polygons which are determined to be visible, at least partially, by the HZ buffer test…"), as shown in Figure 2 as step 50, therefore as occlusion is tested, an indication of the results of the test is recorded to represent the visibility. Xie teaches processing pixels in rows of pixels corresponding to the row of tiles for the graphics primitive in a row-by-row manner responsive to the occlusion flags in column 8 lines 57-58 ("…the tiles of display screen 18 are processed sequentially."), where it is

described that the pixels within the tile are processed sequentially, therefore the sequential processing of the pixels within each tile is also sequentially processed for each row within that tile in order, and as a result the pixels are processed in a row-by-row manner. Xie teaches establishing a depth buffer configured to store respective occlusion threshold depth values for respective pixels of the graphics display field in column 2 lines 29-32 ("The method comprises rendering the polygons in each tile of the scene in depth order, starting with a closest polygon, and storing their pixel depths in the Z-buffer."). Xie teaches performing a test on each tile to determine occlusion in column 5 lines 22-24 ("Polygons from subsequent bins undergo the visibility test (box 50) against the HZ buffer before they are rendered."), therefore with respect to the illustrated steps 50-62 of Figure 2, an indication of the result of the occlusion test is performed in step 50. Xie illustrates processing the pixels comprises detecting that the tile has an occlusion flag indicating possible occlusion in step 50 of Figure 2, where an occlusion test is performed on the tile, therefore an indicator is produced which would provide an indication of possible occlusion. However, Xie fails to teach the remaining limitations. Larson teaches comparing a depth value for the graphics primitive for a pixel in the tile to an occlusion threshold depth value for the pixel in the depth buffer responsive to detecting that the tile has an occlusion flag indicating possible occlusion and updating the occlusion threshold depth value for the tile in the tile occlusion information cahce responsive to the written z-value of the pixel in column 2 lines 52-61 ("If a determination is made that the Z value is less than or equal to the maximum Z value for the region, the controller determines whether the received Z value is less than the minimum Z value for the region stored in the cache memory element. If the controller determines that the received Z value is less than the minimum Z value for the region stored in the

cache memory element, the controller stores the received Z value at a particular location in the cache memory element and tags the location with a tag indicating that location contains a valid Z value."). It would have been obvious to one of ordinary skill in the art to combine the teachings of Xie with Larson because this combination would enable a reduction the amount of processing required to display a primitive through dividing the display into tiles in order of their respective depth values, as taught by Xie in column 3 lines 10-15, in which during processing of the tile the cached depth values of those regions are compared to determine if the tiles are occluded, as taught by Larson in column 1 lines 19-28, thereby avoiding unnecessary processing of hidden primitives.

Regarding claim 10, Xie fails to teach the limitations. Larson teaches establishing a color buffer configured to store respective color values for respective ones of the pixels of the graphics display field in column 1 lines 13-19 ("...systems typically comprise a frame buffer memory which stores the color and Z coordinate associated with each pixel to be displayed...A frame buffer controller of the computer graphics display system controls the process of writing the Z coordinates and the colors of the pixels to the frame buffer memory..."), where processing the pixel comprises storing a color vale and a depth value in the color buffer and depth buffer, respectively, if the comparison of the depth value for the graphics primitive for the pixel in the tile to the occlusion threshold depth value for the pixel in the depth buffer indicates non-occlusion and updating the occlusion threshold depth value for the tile in the tile occlusion information cache responsive to the written z-value of the pixel in column 1 lines 13-28 ("...systems typically comprise a frame buffer memory which stores the color and Z coordinate associated with each pixel to be displayed...Z buffer depth comparison tests are used to

determine whether a new Z coordinate received in the frame buffer controller corresponds to a pixel that will be visible when displayed, or whether the pixel associated with the new Z coordinate will be occluded or hidden if displayed. If the pixel will be occluded, it is unnecessary to write the Z coordinate and the associated color to the frame buffer memory and the pixel can be discarded."), where it is described that visible pixels are displayed without retrieving threshold depth values and the frame buffer, which server as the color buffer and depth buffer, contains the color of those displayed pixels. The motivation to combine the teachings of Xie with Larson is equivalent to the motivation of claim 9.

Regarding claim 11, Xie teaches defining a plurality of rows of tiles in a graphics display field comprising a plurality of rows of pixels, each tile including pixels from at least two rows of pixels in column 4 lines 43-46. Xie also teaches setting occlusion flags for respective tiles of a row of tiles for a graphics primitive based on whether respective representative depth values for the tiles of the row of tiles meet an occlusion criterion in column 5 lines 1-2 ("Polygons which are determined to be visible, at least partially, by the HZ buffer test…"), as shown in Figure 2 as step 50, therefore as occlusion is tested, an indication of the results of the test is recorded to represent the determination of visibility. Xie teaches recording a status flag for respective tiles of the row of tiles in column 8 lines 57-59 ("…the tiles of display screen 18 are processed sequentially. If there are no more tiles to process, the process ends…"), where a determination is made as to whether each tile has been processed or visited. Xie also teaches processing pixels in rows of pixels corresponding to the row of tiles for the graphics primitive in a row-by-row manner responsive to the occlusion flags in column 8 lines 57-58 ("…the tiles of display screen 18 are processed sequentially."), where it is described that the pixels within the tile are processed

sequentially, therefore the sequential processing of the pixels within each tile is also sequentially processed for each row within that tile in order, and as a result the pixels are processed in a row-by-row manner. Xie also teaches processing a first row of pixels responsive to the occlusion flags and depending on the geometry of the primitive, processing pixels in a second tile of the row of tiles responsive to the occlusion flags if the second row of pixels is in the first row of tiles in column 8 lines 58-67 ("the tiles of display screen 18 are processed sequentially ...The process also goes to box 132, in an "early bailout" mode as mentioned earlier, if the nearest Z extent of the bin is further than the furthest Z-buffer value in the tile, indicating that no further polygons in this bin are visible."), where it is described that once a first tile is processed, a second subsequent tile may be then processed before processing additional portions of the first tile. Xie teaches processing a second row of pixels using information in the tile occlusion cache gained from the first row of pixels if the second row of pixels is in the first row of tiles in column 8 lines 58-67 ("...the tiles of display screen 18 are processed sequentially...The process also goes to box 132, in an "early bailout" mode as mentioned earlier, if the nearest Z extent of the bin is further than the furthest Z-buffer value in the tile, indicating that no further polygons in this bin are visible."), where it is described that a second row or portion of another tile would be processed. Xie teaches setting occlusion flags for tiles of a row of tiles in column 5 lines 1-2 ("Polygons which are determined to be visible, at least partially, by the HZ buffer test..."), as shown in Figure 2 as step 50, therefore it is implicitly taught that as occlusion is tested, an indication of the results of the test is recorded to represent the visibility. Xie also teaches recording a status flag for respective tiles of the row of tiles in column 8 lines 57-59 ("...the tiles of display screen 18 are processed sequentially. If there are no more tiles to process, the process ends..."), where a

determination is made as to whether each tile has been processed or visited. However, Xie fails to teach the remaining limitations. Larson teaches that occlusion flags are stored in a tile occlusion cache that is configured to store respective occlusion flags for respective tiles of a row of tiles and respective occlusion threshold depth values for the respective tiles of the row of tiles and in column 5 lines 33-35 ("The cache memory element contains a sufficient number of locations for storing Z values for at least one region of pixels and the Z MAX and Z MIN values for the region.") and in column 6 lines 23-25 ("...a determination is made as to whether the primitive is visible."), where it is described that the determination of visibility is performed for the tile of pixels, therefore an indicator is acquired that provides the result of the tested visibility. Larson teaches processing a first row of pixels responsive to the tile occlusion cache in column 2 lines 64-67 ("...the controller determines whether the minimum and maximum Z values for the region associated with the received Z value are already contained in the cache memory element.") and in column 4 lines 40-47 ("...the Z MIN and Z MAX values are read out of the Z limit buffer by the memory controller 41...to perform the depth comparison test for the pixels of the region. The regions are not limited to any particular number of pixels. A region may comprise...a 4X4 group of pixels."). Larson teaches determining whether a second row of pixels is in the first row of tiles in column 6 lines 5-18 where it is described that the tile data is stored in a cache, therefore using data from the cache memory it would have been a minor modification to obtain information from a first row of pixels if the second row of pixels is contained the first row of tiles. It would have been obvious to one of ordinary skill in the art to combine the teachings of Xie with Larson because this combination would enable a reduction the amount of processing required to display a primitive through dividing the display into tiles in order of their respective

depth values, as taught by Xie in column 3 lines 10-15, in which during processing of the tile the cached depth values of those regions are compared to determine if the tiles are occluded, as taught by Larson in column 1 lines 19-28, thereby avoiding unnecessary processing of hidden primitives.

Regarding claims 15 and 20, Xie illustrates a display and graphics process in Figure 1 as elements 18 and 12 respectively.

Regarding claim 19, Xie teaches that the graphics processor and display is illustrated in Figure 1 could be implemented in a variety of computer systems or devices, as described in column 1 lines 15-23, such as wireless devices, as described in column 3 lines 61-63.

Regarding claims 21 and 27, Xie illustrates a graphics processor is operative to maintain a depth buffer in Figure 1 where it is shown that the graphics processor 12 communicates with the z-buffer 16 via bus 6, and is configured to store respective occlusion threshold depth values for respective pixels of the graphics display field in as described in column 2 lines 29-32 ("...rendering the polygons in each tile of the scene in depth order, starting with a closest polygon, and storing their pixel depths in the Z-buffer."). Xie illustrates responsively processing a pixel for the graphics primitive in the tile without retrieving an occlusion threshold depth value for the pixel from the depth buffer in step 106 of Figure 3A, where it is illustrated that the pixels defining the graphics primitive are processed without referencing an occlusion threshold depth value.

Regarding claim 22, Xie fails to teach the limitations, however Larson teaches in column 3 lines 43-48 that the host memory is coupled to the processing unit, as illustrated in Figure 1, therefore the CPU is operative to maintain the cache memory of the system. Larson teaches that

occlusion flags are stored in a tile occlusion cache that is configured to store respective occlusion flags for respective tiles of a row of tiles and respective occlusion threshold depth values for the respective tiles of the row of tiles and in column 5 lines 33-35 ("The cache memory element contains a sufficient number of locations for storing Z values for at least one region of pixels and the Z MAX and Z MIN values for the region.") and in column 6 lines 23-25 ("...a determination is made as to whether the primitive is visible."), where it is described that the determination of visibility is performed for the tile of pixels, therefore an indicator is acquired that provides the result of the tested visibility. Larson also teaches determining a maximum depth value for the graphics primitive within a tile in column 4 lines 30-32 ("...the Z values within each region are compared to determine...the maximum Z value, Z MAX, for each region."). Larson implicitly teaches comparing the maximum depth value to the cache occlusion threshold depth value for the tile in the tile occlusion information cache, in column 6 lines 25-27 ("The received Z value is then compared with the Z MIN value. If the received Z value is less than Z MIN, the primitive is visible."), that comparing the maximum depth value of a tile to the cached depth value to determine visibility is equivalent to comparing any particular depth value to a cache minimum depth value because both comparisons enable the determination of visibility of a particular region or tile of pixels in relation to previously stored depth values. Larson implicitly teaches setting an occlusion flag for the tile responsive to the comparison in column 6 lines 26-29 ("If the received Z value is less than Z MIN, the primitive is visible...the received Z value is written to the corresponding location in cache memory, as indicated by block 81..."), where it is described that an indication of occlusion is produced, such as a tag or flag, from the result of the

test which indicates the occlusion properties of the tile. The motivation to combine the teachings of Xie with Larson is equivalent to the motivation of claim 41.

Regarding claims 23, 26 and 40, Xie teaches a computer program product comprising program code embodies in a computer-readable medium in column 4 lines 22-28.

Regarding claim 31, Xie illustrates processing a pixel including rendering the pixel without comparing a depth value thereof to an occlusion threshold value responsive to determining that the occlusion flag setting indicates that the graphics primitive is not occluded in the tile in step 44 of Figure 2, where it is illustrated that the pixels defining the graphics primitive are processed without referencing an occlusion threshold depth value.

Regarding claim 32, Xie fails to teach the limitations. Larson also teaches determining a maximum depth value includes determining a depth value greater than or equal to all possible depth values that the graphics primitive may have in a tile in column 4 lines 30-32 ("...the Z values within each region are compared to determine...the maximum Z value, Z MAX, for each region.") and in column 1 lines 59-60. The motivation to combine the teachings of Xie with Larson is equivalent to the motivation of claim 41.

Regarding claim 33, Xie fails to teach the limitations. Larson teaches determining a maximum depth value, in column 1 lines 59-60 ("The maximum Z value corresponds to the largest Z value of a region of Z values."), comprises determining a maximum depth of vertices of the graphics primitive in column 2 lines 10-13 ("Each primitive has Z values associated with each vertex of the primitive. Each received Z value is associated with a region of Z values in the Z buffer memory device"). The motivation to combine the teachings of Xie with Larson is equivalent to the motivation of claim 41.

Regarding claim 34, Xie fails to teach the limitations. Larson teaches determining a maximum depth value comprising determining a maximum depth of a plane or image of the graphics primitive in the tile in column 1 lines 31-40 ("In these types of systems, Z buffer depth comparison tests are performed by reading the old Z coordinate for the pixel from the Z buffer…writing the new Z coordinate and the associated pixel color into the Z buffer and image buffer…") and in column 1 lines 59-60 ("The maximum Z value corresponds to the largest Z value of a region of Z values."). The motivation to combine the teachings of Xie with Larson is equivalent to the motivation of claim 41.

Regarding claim 35, Xie fails to teach the limitations. Larson teaches establishing a tile occlusion cache that is configure to store respective occlusion flags for respective tiles of a row of tiles and respective minimum depth values for the respective tiles of the row of tiles in column 5 lines 33-35 ("The cache memory element contains a sufficient number of locations for storing Z values for at least one region of pixels and the Z MAX and Z MIN values for the region.") and in column 6 lines 23-25 ("…a determination is made as to whether the primitive is visible."), where it is described that the determination of visibility is performed for the tile of pixels, therefore an indicator is acquired that provides the result of the tested visibility. Larson also teaches comparing the maximum depth value for the graphics primitive to a minimum depth value for the given tile store in the tile occlusion cache in column 2 lines 17-21 ("If a determination is made that the Z value is less than or equal to the maximum Z value for the region, the controller determines whether the received Z value is less than the minimum Z value for the region.") and in column 2 lines 40-42 ("…the controller comprises a cache memory element for storing a region of Z values and the maximum and minimum Z values associated

with the region."). Larson implicitly teaches setting an occlusion flag for the tile responsive to the comparison in column 6 lines 26-29 ("If the received Z value is less than Z MIN, the primitive is visible...the received Z value is written to the corresponding location in cache memory, as indicated by block 81..."), where it is described that an indication of occlusion is produced, such as a tag or flag, from the result of the test which indicates the occlusion properties of the tile. The motivation to combine the teachings of Xie with Larson is equivalent to the motivation of claim 41.

Regarding claim 36, Xie teaches that the given tile is a first tile in a row of tiles, each row of tiles including at least two rows of pixels, in column 4 lines 43-46. Xie also teaches processing pixels for the graphics primitive in a row-by-row fashion in column 8 lines 57-58 ("...the tiles of display screen 18 are processed sequentially."), where it is described that the pixels within the tile are processed sequentially, therefore the sequential processing of the pixels within each tile is sequentially process the pixels within each row within that tile in order in a row-by-row manner. The motivation to combine the teachings of Xie with Larson is equivalent to the motivation of claim 41.

Regarding claim 38, Xie teaches processing a first portion of a given tile for the graphics primitive and processing a second portion of a second tile and subsequently processing a second portion of the tile for the graphics primitive in column 8 lines 58-67 ("the tiles of display screen 18 are processed sequentially...The process also goes to box 132, in an "early bailout" mode as mentioned earlier, if the nearest Z extent of the bin is further than the furthest Z-buffer value in the tile, indicating that no further polygons in this bin are visible."), where it is described that

once a first tile is processed, a second subsequent tile may be then processed. The motivation to combine the teachings of Xie with Larson is equivalent to the motivation of claim 41.

Regarding claim 39, Xie illustrates an apparatus comprising a graphics processor in Figure 1.

Regarding claim 41, Xie teaches dividing a graphics display into a plurality of tiles, each tile comprising a plurality of pixels in column 4 lines 43-46. Xie also teaches setting an occlusion flag for a given tile to indicate that the graphics primitive is not occluded in column 3 lines 10-15 ("...a single layer, hierarchical Z-buffer (HZ) is constructed from the Z-buffer thus far accumulated for the rendered bins. Subsequent bins have their polygons tested against the HZ buffer to see if these polygons are hidden. If they are hidden, they are culled...") and in column 5 lines 1-2 ("Polygons which are determined to be visible, at least partially, by the HZ buffer test..."), where it is described that as occlusion is tested, an indication of the results of the test is recorded to represent the visibility. Xie also teaches processing a pixel within a given tile or region for the graphics primitive responsive to setting an occlusion flag in column 3 lines 10-15 ("...a single layer, hierarchical Z-buffer (HZ) is constructed from the Z-buffer thus far accumulated for the rendered bins. Subsequent bins have their polygons tested against the HZ buffer to see if these polygons are hidden. If they are hidden, they are culled..."), where it is described that when the tile fails the visibility test, the primitive is hidden, therefore the pixel is processed or displayed dependent upon the determination of the calculated occlusion indicator. Xie fails to teach the remaining limitations. Larson teaches determining a maximum and minimum depth value for a graphic primitive and pixels within a given tile in column 1 lines 55-57 ("...minimum and maximum Z values are calculated for each region of Z values stored in a Z

buffer memory device."). Larson also teaches determining whether the minimum depth value for the given tile exceeds the maximum depth value for the graphic primitive in column 2 lines 17-21 ("If a determination is made that the Z value is less than or equal to the maximum Z value for the region, the controller determines whether the received Z value is less than the minimum Z value for the region."). It would have been obvious to one of ordinary skill in the art at the time of invention to combine the teachings of Xie with Larson because this combination would enable a reduction the amount of processing required to display a primitive through dividing the display into tiles in order of their respective depth values, as taught by Xie in column 3 lines 10-15, in which during processing of the tile the cached depth values of those regions are compared to determine if the tiles are occluded, as taught by Larson in column 1 lines 19-28, thereby avoiding unnecessary processing of hidden primitives.

Claims 3, 17, 25 and 37 are rejected under 35 U.S.C. 103(a) as being unpatentable over Xie in view Larson in further view of Wood (US Patent 6,204,856).

Regarding claim 3, Xie and Larson fail to teach the limitations. Wood teaches processing pixels contained in the rows of tiles using a zig-zag traversal algorithm in column 5 lines 15-20. It would have been obvious to one of ordinary skill in the art to combine the teachings of Xie, Larson and Wood because this combination would provide an efficient algorithm that accurately processing the rows of pixels within a tile through avoidance of pixels that do no contain a portion of the primitive.

Allowable Subject Matter

The following is an examiner's statement of reasons for allowance:

Claims 12 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. The prior art, Xie (US Patent 6,525,726) and Larson (US Patent 6,313,839), do not teach or suggest, setting the occlusion and status flags in the tile occlusion information cache to predetermined values an storing occlusion threshold depth values for the first row of tiles form the aggregate tile occlusion information memory in the tile occlusion information cache, as recited in claim 12.

Claims 13 and 14 are allowed.

The prior art, Xie and Larson , do not teach or suggest, responsive to determining that the second row of pixels is in a second row of tiles writing back the occlusion threshold depth values from the tile occlusion information cache to the aggregate tile occlusion information in the tile occlusion information cache, loading occlusion threshold depth values into the tile occlusion information cache with corresponding occlusion threshold depth values for the second row of tiles form the aggregate tile occlusion information memory, and processing the second row of pixels using the updated tile occlusion cache, as recited in claim 13.

Response to Arguments

Applicant's arguments with respect to claims 1, 3, 5, 17, 19-23, 25-27 and 31-41 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Said Broome whose telephone number is (571)272-2931. The examiner can normally be reached on 8:30am-5pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Ulka Chauhan can be reached on (571)272-7782. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

S. Broome SB
11/8/06

Ulka Chauhan
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SUPERVISORY PATENT EXAMINER